MULTI-CHANNEL DATA ACQUISITION SYSTEM SPECIFICATION

The Multi-Channel Data Acquisition System to be furnished will be used for the following:
- Acquiring raw time series data and storing for later analysis.
- Acquiring Narrowband and fractional Octave band (synthesized and ANSI) acoustic data up to 100kHz.
- Acoustic data will be analyzed using stable averaging, exponential averaging, and maximum and minimum holding.
- Acoustic Data will be simultaneously stored and analyzed.
- Vibration levels will be displayed in displacement and acceleration for spectral and autopower functions.
- Both voltage and ICP accelerometers, hydrophones, and microphones will be used.
- Embedding acoustic data in Microsoft office documents for reporting purposes.

The Multi-Channel Data Acquisition System to be furnished shall possess the following operational and performance features and characteristics:

Hardware

- 8 input channels
- Supports direct transducer coupling for voltage and ICP
- Sample rate up to 204 kHz
- Simultaneous throughput to host PC disk while processing (FFT, third octave)
- Software controlled channel setup with hardware LED indicators

Data Acquisition Software:

- Direct access to any ODBC (Micosoft Office) database for transducer information
- Embedded, user-specified, documentation
- Channels can be grouped into vibration, acoustic, static and tachometer channels
- Support for multiple reference channels
- Averaging methods include stable averaging, exponential averaging, Maximum hold and Minimum hold
- Following functions be provided: Time, Spectra, Frequency Response Functions (FRF) (H1,H2, Hv), Octave Band and Fractional Octave Band Analysis (1/1, 1/2 1/3, 1/6, 1/12, 1/24) - with ANSI emulation, Cross-Power, Auto-Power, and Sound Intensity. FRF's and crosspowers are calculated between responses and all reference channels.
- Simultaneous throughput to host PC disk while processing (FFT, order track, real-time third octave bands)
- Vibration channels be converted online to displacement/velocity/acceleration for spectra and autopower functions
- User-configurable display layouts with 2D (Front/Back, Upper/Lower, Octave, Bode), waterfall and colormap displays
- Single, double, harmonic, ratio and crosshair cursors
- Change cursor properties, annotation style, amount of decimal places
- Support for embedding of data in Microsoft documents (e.g. Word, Excel, Powerpoint) using Active Pictures

Recorded Time Data Processing Software:

Displays/Plotting:

- Static Display (2D-3D Functions): Front/Back, Upper/Lower, Nyquist, Octave, Waterfall, Color Map: link of time and frequency cursors/selected segments with other displays/forms through software bus.
- Strip Chart Display: Multi-channel, Overview, Detailed (zoom), Indicators (Meter, Digital, Bar) with user definable alarm levels and functions (RMS, MAX, MIN, Cursor Value), Auto-tailing, Segment and Cursor selections, user definable markers (point or segment). Automatic scrolling
- Powerful plot-format editor allows user definable plot formats (any type/combination of windows, drawing capabilities, text annotation, inclusion of color bitmaps/logos) interactive, automatic and batch plotting modes; automatic reduction for large time histories.

User Attributes/Markers:

- All time history data be complemented with (any number of) user definable attributes of following types: float, integer, string, ordinate (start, increment, rate), variable length (eg. extra data dump).
- User attributes are stored with data in the same file: can be consulted at any moment.
- User Attributes can be defined on the level of the Time Data File (multiple channels) or the recording (one channel).
- Markers: point or segment markers can be graphically set for identifying specific events/segments. Markers view: 6 color, 3 line styles, 3 thickness.
- Markers editing: cut, copy, paste, move, duplicate, modify, add, key code, description.

Editing:

- Icon driven graphical editing, single- or multi-channel
- Editing operations: undo, cut, copy, truncate, duplicate, insert at cursor, overwrite at cursor, replace segment, modify segment (offset, mean, scale, RMS, replace by constant, replace by curve), mute, straighten
- Fading: none, linear, 1/2 cosine, power, mute for user definable duration.

Trace Manipulation:

- Align, Multiplex and De-multiplex, Mix, Revert, Compose
- Interpolate: spline, polynomial, sinc
- Digital re-sampling: up/down, any new frequency or ratio, configurable anti-alias filtering
- Trend removal
- Curve fitting
- Moving and Exponential Average

Trace Analysis:

- Conversion of pulse-train(s) to rpm or angle trace with user definable: # pulses, transmission, cross-level, upper/lower tolerances, hold-off %, up-sampling and equidistant interpolation
- Envelope analysis based on Hilbert transform
- Sine Analyzer: amplitude, phase, frequency and sampling speed
- Sine Calibration: dB/Lin, multi-channel
- Quick single value statistics: min (x,y,index), max (x,y,index), mean, RMS
- Histogram: standard, cumulative, probability, density, normalization

Trace Mathematics:

- Any mathematical expression (+, -, *, ÷) between traces and/or scalars, all provided in a trace calculator.
- Integration: time domain (trapezium, Simpson, four point & Bode), frequency domain.
- Differentiation: time & frequency domain.

Trace Generation:

- Signal generator: sine, sweep, saw-tooth, square, random noise, controlled oscillator (with user definable carrier frequency and amplitude; fixed and variable frequency and phase deviations)

Audio Feedback:

- All time history data can be played back through the multi-media outputs of the HP9000 workstation or Windows NT/2000 PC (16 bit, CD quality)
- Replay of segment or starting at cursor through internal speaker or external headphones/speaker system.

Frame Statistics:

- Statistic evaluation on multi-channel time histories: frame length in samples or seconds, overlap in %, samples or seconds.
- Statistical functions: min, max, range, extremum, sum, mean, variance, skewness, kurtosis, standard deviation, rms, crest factor, mean absolute deviation, extreme deviation, Markov regression, 10th-25th-75th and 90th-percentile, median, integration.

Spectral Processing:

- Any spectral function on complete/segments multichannel time histories, with logging of processing history.
- Spectral Functions: DFT, FFT, Maximum Entropy Method (MEM), autopower, multiple input multiple output (MIMO) crosspower, MIMO FRF, impulse response, MIMO coherence, principal component analysis (PCA), autocorrelation (time & frequency domain), crosscorrelation (time & frequency domain), 3D spectral map, 3D MEM map.
- Processing parameters: any block size (no limit on size), format (linear. power or power spectral density - PSD), scale (peak, RMS), window (Uniform, Hanning, Hamming, Kaiser-Bessel, flattop), weighting (A, B, C, D)
- Optional Time Variant Frequency Analysis (Wavelets, Wigner-Ville)

Digital Filtering:

- Finite impulse response (FIR): Window, Multi-window, Remez
- Infinite impulse response (IIR): Bessel, Butterworth, Chebyshev, Inverse Chebyshev, Cauer, Inverse design.
- Arbitrary FRF
- Graphical definition of cut-off frequencies through single and double cursors.
- Direct graphical interpretation of filter frequency response function FRF, phase and group delay.
- Capability of grouping different filters in one filter with user definable name.
- Multiple filters (software regulates ideal cascading) can be set for filtering multiple channels at the same time.
- Filter modes: direct, zero-phase.
- User-designed filters can be saved in user-definable defaults for later use.
- Octave Filtering: ANSI-IEC compliant 1 and 1/3 Octave filtering (multiple bands in one run). - Harmonic Tracking (Kalman fixed frequency and order filtering)

Counting:

- Range-pair, Extremum, Level crossing, mean, range, range-pairmean, range-pair-range

Customization:

- A snap-shot function allows the user to define specific layouts and save specific processing parameters for a specific processing tasks. Multiple snap-shots can be saved under different names

and recalled whenever required. The snap-shot function exists for : Digital Filtering, Frame Statistics and the main Time Data Processing layer.

- Configurable menubar and ICON toolbar: the user can configure the menu entries, as well as ICONS in the processing toolbar, which will start a specific command or a user program.
- A special mechanism (basename & context) allows the system to be configured for specific tasks. In this way user interface and processing options will depend on the type of task one will have to perform; eg. one can have a set-up for analyzing one type of test article, and a totally different one for a different type of test article with different defaults and options.

The Multi-Channel Data Acquisition System to be furnished must also capable of being expanded or modified to accommodate the following:

Hardware

- Expandable up to 960 input channels
- Support for direct transducer coupling, including charge, strain and microphone
- Support for tachometer conditioning and order tracking
- Simultaneous throughput to host PC disk while processing (order track, real-time third octave)

Recorded Time Data Processing Software:

Data I/O

- Instrument recorder interfaces (optional): SONY PC200 Series, SONY SIR-1000, TEAC RD and RX Series, RACAL-HEIM DataRec Series, Audio DAT & Head Acoustics HDR-IV, OPTIM MEGADAC, Metrum RSR-512, RACAL Storeplex range, A480, RACAL HEIM
- File Translators (optional): MTS RPCIII™, nCode nSoft DAC™, HP SDF™.

Trace Manipulation:

- Adaptive re-sampling from any reference domain to any reference domain and back again (e.g. resample using engine RPM to angle domain)

Spectral Processing:

- Time Variant Frequency Analysis (Wavelets, Wigner-Ville)

Digital Filtering:

- Harmonic Tracking (Kalman fixed frequency and order filtering)

Block Data Processing:

- Allow manipulation of time history traces, as well as results blocks (spectra, histograms, waterfall maps).
- Development of macro-based autosequences for automatic sequential processing.